NOTICE

THIS DOCUMENT HAS BEEN REPRODUCED FROM MICROFICHE. ALTHOUGH IT IS RECOGNIZED THAT CERTAIN PORTIONS ARE ILLEGIBLE, IT IS BEING RELEASED IN THE INTEREST OF MAKING AVAILABLE AS MUCH INFORMATION AS POSSIBLE

NASA CR 152226

DESIGN AND FABRICATION OF A
FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM

FINAL REPORT

BY

DAVID F. PUTNAM

NOVEMBER 1978



DISTRIBUTION OF THIS REPORT IS PROVIDED IN THE INTEREST OF INFORMATION EXCHANGE. RESPONSIBILITY FOR THE CONTENTS RESIDES IN THE AUTHOR OR ORGANIZATION THAT PREPARED IT.

PREPARED UNDER CONTRACT No. NAS2-9677

BY

UMPQUA RESEARCH COMPANY
MYRTLE CREEK, OREGON

FOR

AMES RESEARCH CENTER

National Aeronautics and Space Administration

(NASA-CR-152226) DESIGN AND FABRICATION OF A FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM Final Report (Umpqua Research Co., Myrtle Creek, Ore.) 38 p HC A03/MF A01

N81-18655

Unclas 16502

CSCL 06K G3/54

UMPQUA RESEARCH

DESIGN AND FABRICATION OF A FOUR-MAN CAPACITY URINE WICK EVAPORATOR SYSTEM FINAL REPORT

NOVEMBER 1978

NASA CR 152226

BY DAVID F. PUTNAM

Prepared for Ames Research Center, National Aeronautics and Space Administration, Under Contract NAS2-9677

UMPQUA RESEARCH COMPANY
P.O. Box 791, Myrtle Creek, Oregon 97457

1.0 INTRODUCTION AND SUMMARY

In this contract, Umpqua Research Company (URC) was responsible for the design and fabrication of a 4-man capacity urine wick evaporator system. This system was shipped to GARD, Inc., Niles, Illinois where it was integrated with a dual catalyst ammonia removal system built by GARD. The integrated system was then tested by GARD to determine the performance characteristics and limitations of the dual catalyst concept. The primary objective of the dual catalyst concept is to remove ammonia and other noxious substances in the gas phase and thereby eliminate the need for and current practice of chemically or electrochemically pretreating urine prior to distillation.

2.0 CONTRACTOR TASKS

2.1 Task 1 - 4-Man Capacity Urine Wick-Evaporator System

The baseline flow diagram of the integrated system is presented in Figure 1. This diagram shows: 1) all the major components of the integrated system; 2) the design temperatures for the air loop and 3) the basic division of responsibility between GARD and URC.

The wick-evaporator system constructed by URC consists of the following:

- a. An air evaporation unit.
- b. Four sets of replaceable wick assemblies.
- c. An air blower.
- d. A urine feed pump.
- e. A urine holding tank.
- f. Controls and instrumentation.

An artists conception of the packaged wick-evaporator system is presented in Figure 2. An assembly sketch depicting how the replaceable wick cartridge fits into its housing is shown in Figure 3.

The 4-man waste input model for this program was established as follows:

	urine <u>lb/day</u>	flush water lb/day	Total <u>lb/day</u>
Water	13.26	3.4	16.66
Solids	. 54	0	54_
TOTAL	13.8	3.4	17.2

The duty cycle was selected as 20 hr/day. Therefore the average design waste input flow rate is:

 $W = 17.2 \text{ lb/day} \div 20 \text{ hr/day} = 0.86 \text{ lb/hr}$

The required air flow to evaporate 0.86 lb/hr of water from the wick cartridge for the projected low flow and high flow conditions is indicated below:

wick inlet air temp 	wick inlet dew point °F	AIR FLOWcfm	EVAPORATION RATE 1b/hr
220	60	8	0.86
200	100	12	0.86

The components of the urine wick-evaporator system are discussed individually in the following paragraphs.

- 2.1.1 <u>Air Evaporator Housing</u>. This stainless steel housing, into which the wick evaporator cartridge is placed, can be seen in Figures 2 and 3. Figure 4 illustrates how to insert the wick cartridge and connect the urine feed line to the bulkhead fitting. When this operation is completed, the top plate must then be bolted in place.
- 2.1.2 Wick Evaporator Cartridges. The design was based upon previously tried and proven concepts using viscose rayon felt for the wicks, polyurethane foam for wick spacers and a series of manifolded feed tubes to supply urine at approximately 1-inch intervals along the transverse length of each wick segment. Sketches of the wick cartridge assembly, together with dimensions of the various components, are shown in Figures 5, 6, and 7.
- 2.1.3 <u>Air Heater</u>. A standard off-the-shelf 900 watt electrical air heater was selected and is shown in an assembly sketch in Figure 8.
- 2.1.4 Air Blower. A ROTRON SL2PL blower was selected. This 115 Vac-1 phase-50/60 Hz blower produces a 28" $\rm H_2O$ head at 12 cfm and uses 390 watts of power.
- 2.1.5 Urine Feed Pump. A Blue-White VS-1860 variable speed chemical metering pump was selected. This positive displacement diaphragm pump delivers a maximum flow of 315 cc/min and has a maximum outlet pressure of 60 psi. It comes with a vinyl suction tube, foot valve and polyethylene discharge tube. This pump was sized to provide "pulse" feeding to the wick, that is, high flow for short increments of time. This mode of operation is required to provide even urine distribution to the wicks without flooding. Sufficient time is provided between pulses to allow the pulsed volume of urine to be removed from its immediate discharge area, by the capillary action of the wick, before the following pulse occurs.

- 2.1.6 <u>Urine Holding Tank.</u> The urine holding tank is constructed of polyethylene plastic. It is approximately 42.8 cm x 35.5 cm x 24.7 cm high (16 7/8" x 14" x 9 3/4") with a hole in the top for filling and insertion of the pump suction tube with its foot valve. The suction tube/foot valve can be easily removed and dropped into a graduated cylinder or other tank if desired.
- 2.1.7 Controls and Instrumentation. A sketch of the control panel is shown in Figure 9. The system is started by activating: 1) the blower power switch; 2) the heater power switch and 3) the pump power switch. From this point on, everything works automatically. The heater controller was set to control the wick cartridge air inlet temperature to 200° F. The urine feed pump controller was set to feed urine when the wick cartridge air outlet temperature exceeded 130° F. The urine feed pump was timed to pulse feed urine as long as the controls called for feed. The "pump-on" and "pump off" intervals were initially set at 10 and 60 sec respectively. These intervals were individually adjustable.

The overall wiring diagram is shown in Figure 10. Wiring for the time delay relays to control the pulse feed cycle of the urine feed pump is also shown in Figure 10.

The operating procedure is summarized in Table 1.

2.1.8 Frame. A sketch of the aluminum mounting frame for the air evap components is shown in Figure 11.

3.

TABLE 1. OPERATING PROCEDURE

- 1. Remove cover plate from unit.
- 2. Install wick packet per diagram shown. (Figure 4)
- 3. Check wick connector to verify unit is plugged into bulkhead fitting.
- 4. Replace cover (arrow toward outlet) and tighten screws.
- 5. Fill holding tank to desired level.
- 6. Turn on blower, heater and pump in that order.
- 7. Unit will control to 200° F on inlet, 130° F on outlet. (If temperature changes are required, they can be changed by removing blue covers on control units and adjusting with control knobs inside).

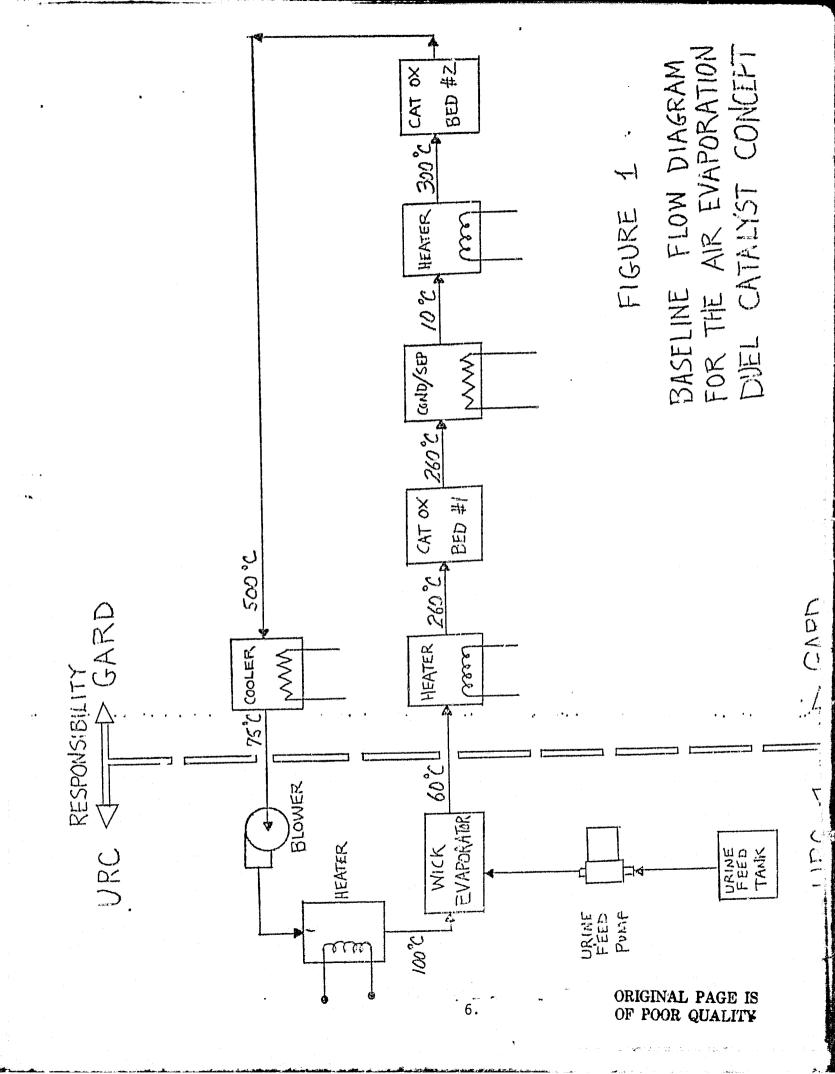
See CONTROL PANEL Diagram (Figure 9)

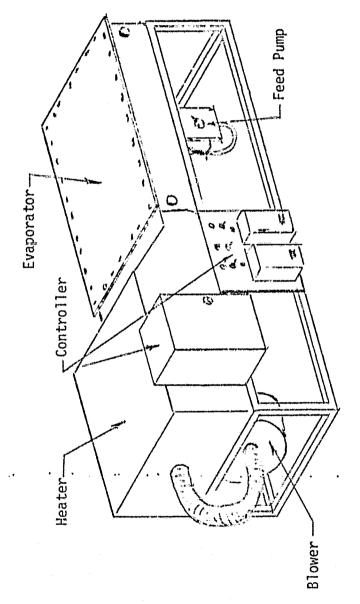
2.2 Task 2 - Preliminary Testing.

Preliminary and final functional tests were conducted at URC in accordance with the test plan presented in Appendix A. These tests demonstrated that all components functioned properly and that the wick evaporator system did meet its design objectives.

2.3 <u>Task 3 - Integration and Test with Dual Catalyst Ammonia Removal System.</u>

Technical consultatio, was provided to GARD during the integration and testing phase. In addition, several samples of the product water were analyzed for heavy metals, organics and other water quality tests recommended by EPA and the American Water Works Association (AWWA). These results are presented in Appendix B.





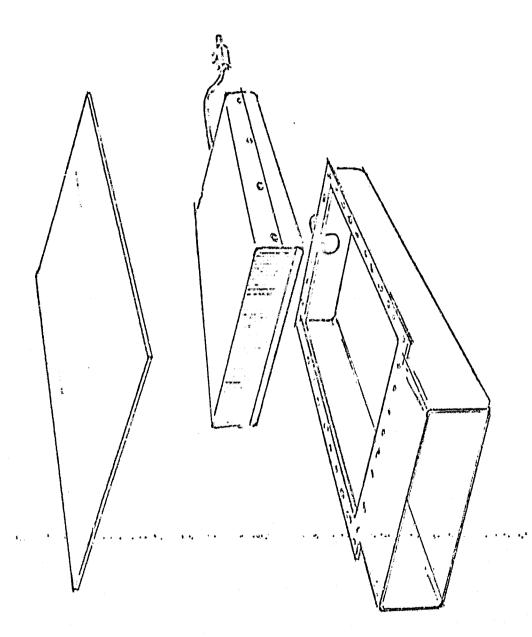
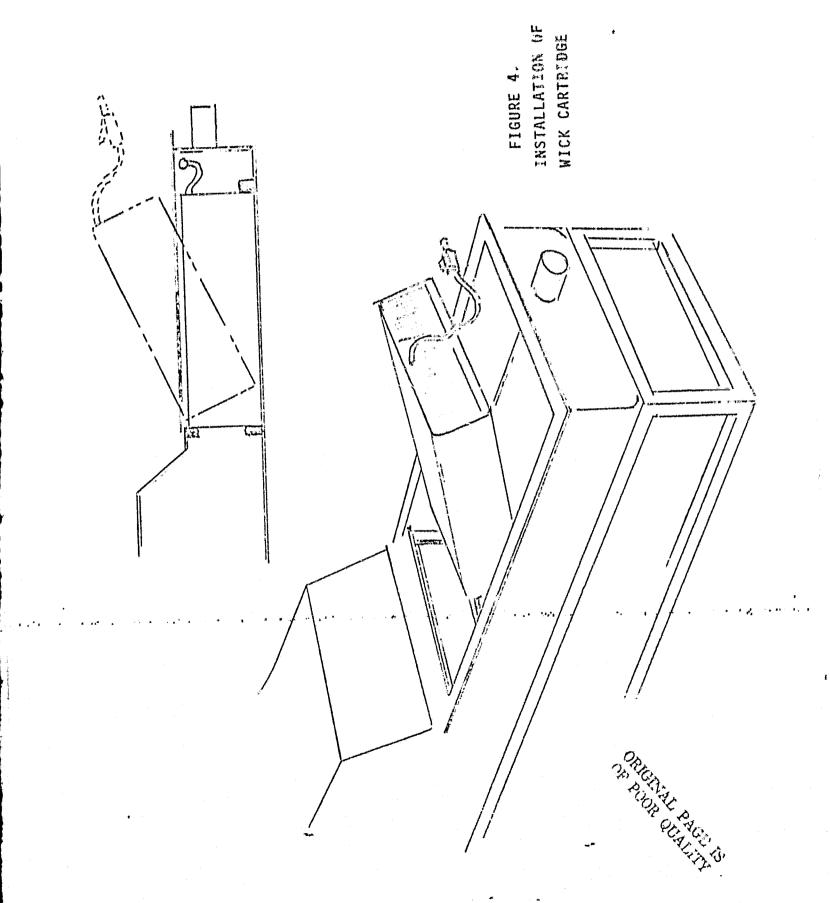
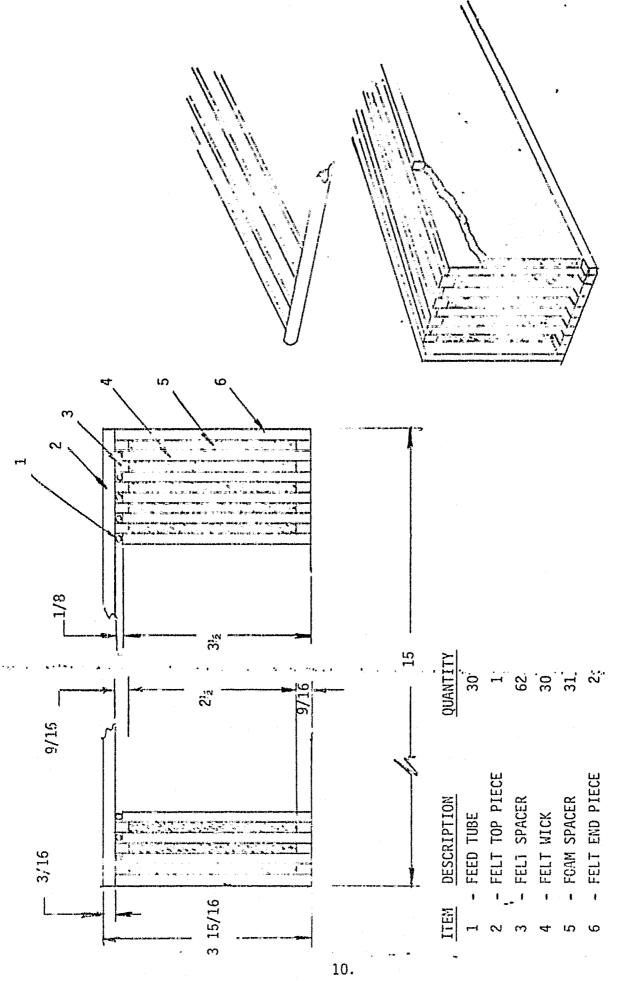


FIGURE 3. WICK CARTRIDGE AND HOUSING





WICK CARTRIDGE ASSEMBLY

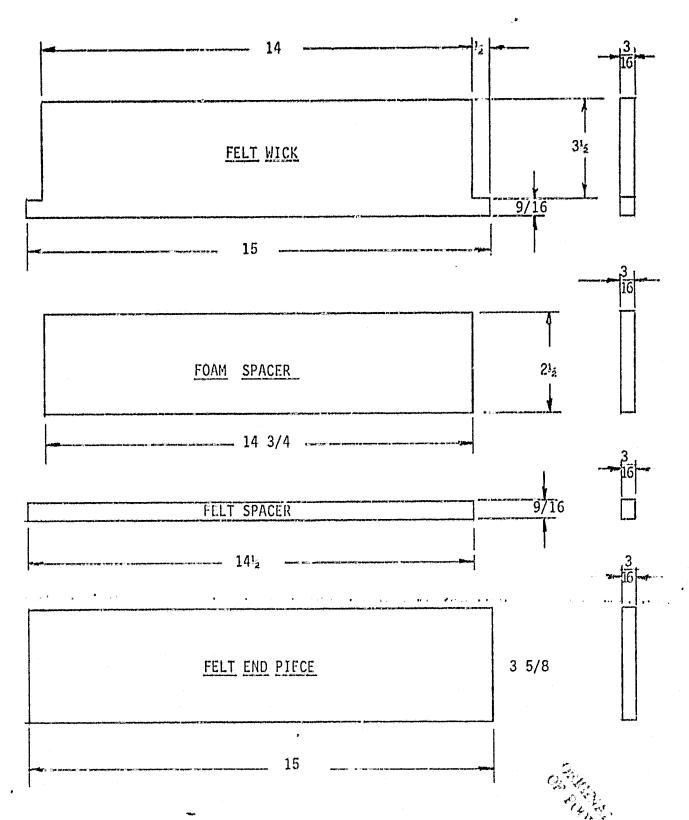
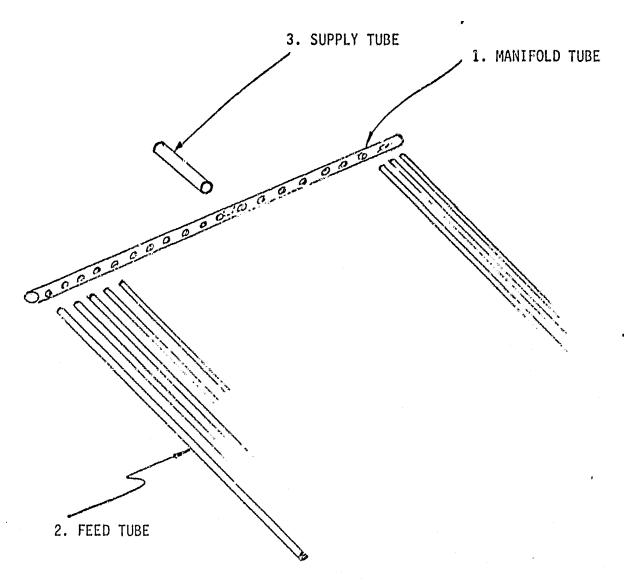


FIGURE 6. WICK CARTRIDGE COMPONENTS -

FIGURE 7. FEED TUBE ASSEMBLY



ITEM DESCRIPTION

- MANIFOLD TUBE 5/16" O.D. 14 3/4" LONG (1 REQ'D)

 DRILL 30 EA. .122" DIA HOLES @ .47" INCREMENTS TO ACCEPT FEED TUBES.

 BEGIN AT .56" IN ONE END. TO BE DRILLED IN LINE THRU ONE WALL ONLY.

 OPPOSITE SIDE OF 30 EA. .122 DIA HOLES, 7 3/8" OR CENTER DRILL .250

 DIA HOLE THRU ONE WALL
- 2. FEED TUBE 1/8" O.D. 12¼" LONG (30 REQ'D)

 DRILL #80 DIA DRILL EQUALLY SPACED © 2 3/8" INCREMENTS. TO BE DRILLED IN LINE THRU ONE WALL ONLY.
- 3. SUPPLY TUBE 1/4" O.D. 1 3/4" LONG (1 REQ'D) TO BE INSTALLED TO 5/16" DIA MANIFOLD TUBE.

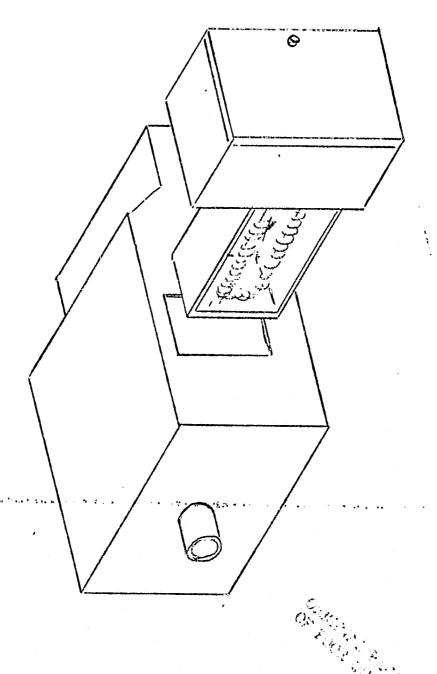
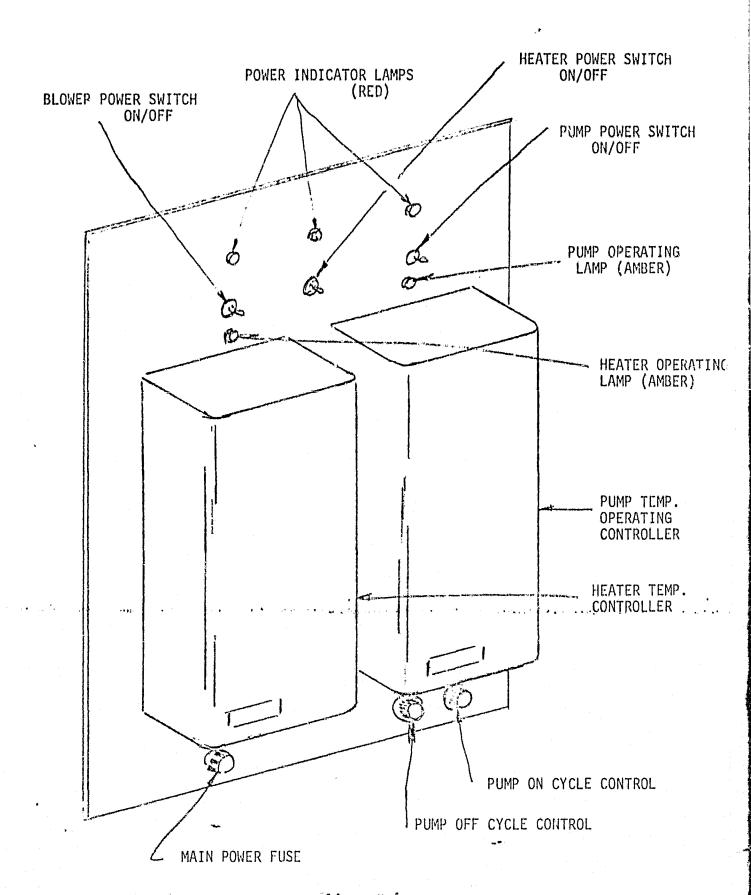


FIGURE 8. AIR HEATER ASSEMBLY



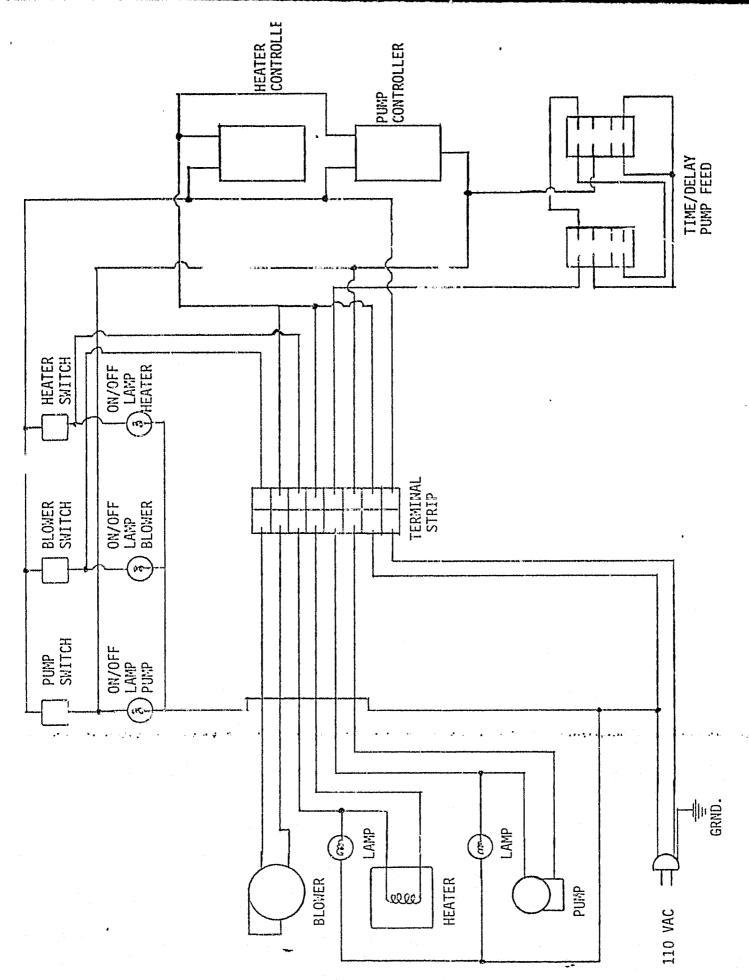
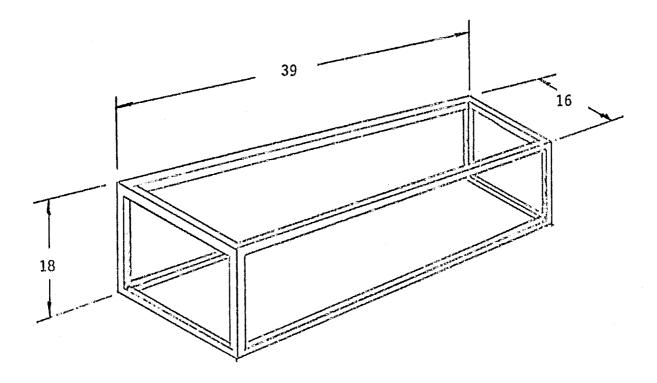


FIGURE 10. OVERALL WIRING DIAGRAM

FIGURE 11. MOUNTING FRAME



APPENDIX A

FUNCTIONAL TEST PLAN

APPENDIX A UMPQUA RESEARCH COMPANY

P. O. Box 791 Myrtle Creek, Oragon 97457 626 N.E. Division Street Telephone (503) 863-5201

FUNCTIONAL TEST PLAN

FOR

URINE WICK EVAPORATOR SYSTEM

NAS2-9677

APRIL 6, 1978

FOR

P.D. QUATTRONE

AMES RESEARCH CENTER

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Subject. Functional test of the Urine Wick-Eyaporator System.

Test Objectives. Verification that individual components, controls and instrumentation are functioning properly and that the system performance meets the design objectives.

System Description. A schematic diagram of the system is presented in Figure 1. A blower delivers air to an electrical heater that raises the air temperature to any desired value between ambient and 220°F. The heated air then passes through the wick evaporator where it picks up moisture from the wet wicks by adiabatic evaporation. In this evaporation process the temperature of the air stream is lowered. The temperature drop is related to the amount of water evaporated. Urine is fed to the wick evaporator from the raw urine tank by a positive displacement pump. The pump is controlled by a temperature signal from the exit air stream. The pump operates in a "pulse feed" mode. The timing of the pulses is controlled by two adjustable time delay relays.

<u>Design Objectives</u>. The urine wick-evaporator system has the following design objectives:

parameter	condition #1	condition #2
evaporation rate, 1b/hr wick inlet dew point F wick inlet air temp, F air flow, cfm	0.86 60 220 8	0.86 100 200 12
blower head, in H ₂ 0	28	27

Test Description. The functional test will be run in the open cycle mode. That is, ambient air will be used. Flow will be adjusted to 12 cfm and the heater exit temperature controller will be set at 200°F. The raw urine tank will be filled with a measured amount of distilled water. The urine feed pump controller will be set to control the wick evaporator exit temperature at 150°F. The pulse feed controller will be set initially at 15 seconds on and 45 seconds off. The functional test will be run continuously for a period of 6 hours. Temperatures, dew points, blower head and component pressure drops will be recorded at 1/2 hour intervals. The wick evaporator exit temperature and power to the urine feed pump will be monitored on a strip chart recorder to provide a visual history of the pulse feed mode. A record of the amount of water fed to the wick evaporator will also be kept.

This test will demonstrate that all components are functioning properly and that the wick evaporator system will meet its design objectives.

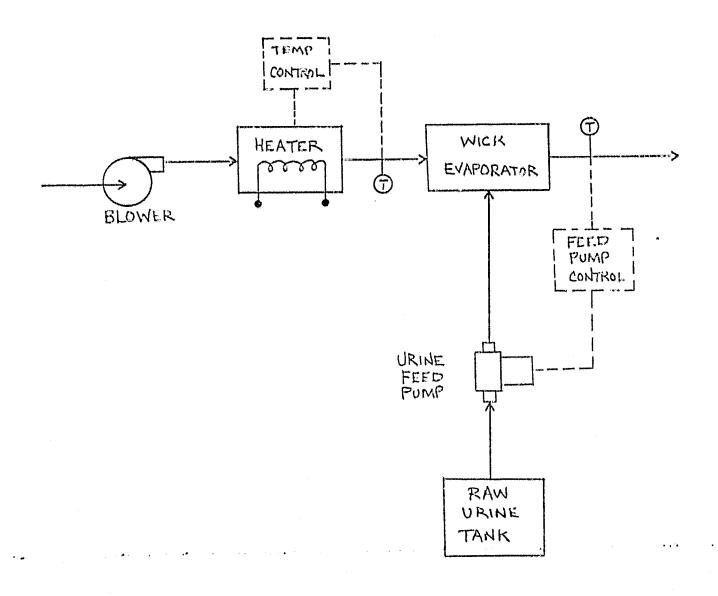


FIGURE A1. WICK EVAPORATOR SYSTEM SCHEMATIC

APPENDIX B PHYSICAL AND CHEMICAL TEST RESULTS ON PRODUCT WATER FROM THE INTEGRATED SYSTEM

P. O. Box 791 Myrtle Creek, Oregon 97457 626 N.E. Division Street Telephone (503) 863-5201

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

NAME GARD, Inc, Attn: Frank Budininkas DATE & TIME COLLECTED Wk of 10-6-78 ADDRESS 7449 N. Natchez Ave., Niles, Ill 60648 DATE RECEIVED 10-20-78						
ADDRESS /449 N. Natch	lez Ave., Niles, II	1 60648			D 10-20-78	i.
WATER SOURCE NASA				re Reporte	D 12-1-78	
COLLECTED BY:			AC SAMPLE		1. 4	·/······
TEST	TEST METHOD	UNITS	LIMITS	RESULTS	DATE OF ANALYSIS	ANALYST
ARSENIC	SM 404 C	MG/L	0.05	N.D.a 0.01	10-25-78	MJS
BARIUM	SM 303 A	MG/L	1.	N.D.0 0.1	11-2-78	MUS
CADMIUM	SM 305 A.	MG/L	0.01	0.0019	11-7-78	DRG
CHROMIUM	SM1307 A	MG/L	0.05	N.D.G 0.02	11~1-78	MJS
LEAD	SM-311 A :	MG/L	0.05	0.106	11-7-78	GVC
MERCURY	SM 315 A	MG/L	0.002	0.24	11-9-78	DRG
NITRATE-NITROGEN	ASTM D992-71	MG/L	10.	1.0	10-25-78 ,	MJS
SELENIUM	SM 318 C 1	MG/L	0.01	N.D.@ 0.002	11-1-78	MJS
SILVER	SM 319 A	MG/L	0.05	N.D.0 10.0	11-1-78	MJS
FLUORIDE	SM 414A & C .	MG/L	1.4 to 2.4	1.0	11-1-78	MJS
ENDRIN	SM 509 A	MG/L	0.0002	NOT TESTED		No.
LINDANE	SM 509 A	MG/L	0.004	11 11		
METHOXYCHLOR	SM 509 A	MG/L	0.1	13 H	, •	•
TOXAPHENE	SM 509 A	MG/L	0.005	11 11		
2,4-D	SM 509 B	MG/L	0.1	11		
2,4,5-T; SILVEX	SM 509 B	MG/L	0.01	и и	,	Websi Ja
pЧ	SM: 424 · · :	pH Units		3.8	10-20-78	DRG
SPECIFIC CONDUCTANCE	SM 205 -	имно/см		54	10-20-78	DRG
1 con = Washous fan th	o Chamias I Analysi	المحالة عمالة	ins 6 Handar	1074		

1 EPA = Methous for the Chemical Analysis of Water & Wastes 1974

SM = Standard Methods for the Examination of Water & Wastewater, 14th Edition

ASTM = ASTM Annual Standards, Part 31

N.D. = None Detectable

APPROVED BY:

Water and Air Crehnology

P. O. Box 791

•

Telephone (503) 863-5201

626 N.E. Division Street Myrtle Creek, Oregon 97457

Gerald V. Colombo
David F. Putnam

TEST RESULTS

NAME	GARD,	Inc.		ITTN ^F	ank Bud	ininkas	DATE1	0-20-78
Address	7449	N. Matchez	Ave., Niles,	111.	60648	DATE	REPORTE	D 12-1-78

	SOURCE	Set #1	ANALYSIS	AMALYST	
	DATE TESTED		DATE		
TEST	SAMPLE #	81020-1			
рН	pH Units	3.8	10-20-78	DRG	
SPECIFIC CONDUCTIVITY	μ mho/cm	54	10-20-73	DRG	
AMMONIA	mg/liter	0.44	11-20-78	DRG	
CYANIDE	mg/liter	no sample			
T,0.C.	mg/liter	2.5	11-27-78	DRG	
G.C. SCAN	hydracarbon	negative	12-1-78	GVC	
			Committee of Children		
t en er en				7	
katan Mangaban kasa ing mga madalan mangan ng kanyan da nang ing biggi pabilih da da nipi pabilih					
lak milandia da da mandan y Byallinia, a di yindada ya dada a daya sandan da					
			· · · · · · · · · · · · · · · · · · ·		
					1
					1
					
erente filosoficiales en en en entre de la region en en entre de decembra en entre de filosoficiales en en ent La companya de la co					
			 		

APPROVED BY-

P. O. Box 791 Myrtle Creek, Oregon 97457

"N.L." means No Limit

N.D. means None Detectable **Insufficient sample

626 N.E. Division Street Telephone (503) 863-5201 ORIGINAL PAGE

PHYSICAL AND CHEMICAL TESTS REQUIRED BY . OREGON STATE HEALTH DIVISION ADMINISTRATIVE RULES CHAPTER 333, MARCH 1976

NAME GARD, Inc.			DATE & TIM	E COLLECT	FDWk of 10-	6-78
ADDRESS 7449 N. Natchez	Ave., Niles, Ill	. 60648			D 10-20-78	
WATER SOURCE NASA-Water				E REPORTE	•	Hamman deliteratura (del
COLLECTED BY:			C SAMPLE #		And an aminopina managaman an aminopina ana aminop	
TEST	TEST METHOD ¹	UNITS	OSHD LIMITS	TEST RESULTS	ANALYSIS DATE	ANALYS
ACIDITY	SM 403	MG/L	N.L.	**		
CALCIUM	SM 306 A	MG/L	N.L.	0.73	11-2-78	MJS
CHLORIDES	SM 408 A	MG/L	250.	2.6	11-10-78	DRG
COLOR (APPARENT)	SM 204 A	COLOR	15.	5	11-10-78	DRG
COPPER	SM 308 A	MG/L	1.0	0.14	11-2-78	MJS
FLUORIDE	SM 414 C	MG/L	2.0	1.0	11-1-78	MJS
HARDNESS (CaCO ₃)	SM 309 B	MG/L	N.L.	**		
IRON	SM 310 B	MG/L	0.3	0.38	11-1-78	MJS
MAGNESIUM	SM 313 B	MG/L	N.L.	0.09	11-2-78	MJS
MANGANESE	SM 314 A	MG/L	0.05	0.01	11-2-78	MJS
NITROGEN, NITRATE	ASTM D992-71	MG/L	10.	1.0	10-25-78	MJS
NITROGEN, NITRITE	EPA p.215	MG/L	N.L.	N.D. () 0.01	10-25-78	DG
ODOR	SM 206	T.O.N.	3.	1	10-20-78	DG
рН	SM 424	рН	N.L.	3,8	10-20-78	DG
*POTASSIUM	SM 317 A	MG/L	N.L.	0.05	11-2-78	MJS
SAND	SM 208 D,E	MG/L	2.	N.D ₁ w	11-1-78	MJS
SILICA	SM 426 B	MG/L	N.L.	**		
SODIUM	SM 320 A	MG/L	N.L.	0.23	11-2-78	MJS
SOLIDS, TOTAL	SM 208 C		1000.	**		
SOLIDS, VOLATILE	SM 208 E	MG/L	N.L.	**		
*SPECIFIC CONDUCTANCE	SM 205	имно/см		59	10-20-78	DG
SELFATES	SM 427 B	MG/L	250.	**		
TURBIDITY	SM 214 A	F	Filtered 1.0 Unfiltered 5.0	0.8	11-10-78	DG
ZINC	SN 303 /4	M9/L	5.0	0.22	11-1-73	MJS
	-			1	,	
*Required by Laboratory for	completion of I	on Balan	ice and Qualy	ity Cont:31	on the Resu	its.

APPROVED BY:

P. O. Box 791 Myrtla Creek, Oregon 97457 626 N.E. Division Street Telephone (503) 863-5732

GARD, Inc. Niles, Ill.

ION BALANCE

Set #1

Comple No				
Sample No.	81020-1	elit ng Tilayan anchan anamangan an palamin sa Aria.	क्षाम् अभवविद्योगितीयाः अस्तिमध्ये स्थापः स्थापः स्थापः स्थापः	
CATIONS, meq/1:	0.000			
Ca ⁺⁺	0.036		C Birman parameterioristica seguinas sep	e manus manus plus spopus services and an approximate for the services and an activities.
Mg ++	0.007	enentin e nenenenen ens eta		n albertalen eine anne og program en skriver
K	0.001			7 3 yr Fransis and Wilde Dynaming on Microscope
Na ^{*t}	0.010			
H [†]	0.158			
Signatural and service and approximate "Applicated Colored Proximation Colored Proximation Colored Col	The state of the s	- Militari ili Salah yang Persang paga apirang yang mengulupan di Afrika dan Silahah	- Antonic Marie, paragram gananga (1955-1946), panahalah sarah darah	
manifestary maint his hand the desired to the construction of the	AND THE PROPERTY OF THE PROPER	er dasi in presidenta angularny a man tokaza. A dasifisahi		- Management (Management (Mana
es, est as à statulaturas consequences que est est submissagent : pacification est est	文·神···································	n o's ground o no management and an individual state of the	e yekri yi yeye amerindi sehenendayense 🗴 ülmbedi kelindi. Saksad	And the same of th
n Kasalajakat Africa Benefatasi Afrikansan in Propinsion alika 5-10 alikuwining daen (1815 yank filoga yan man Tanan alika 1815 yang daen	0.212	v 1958e benegementellegenis pli lincidellita (1965) dicabiel de las de 1965 ser		
ECATIONS	— И вы 1 ды — шин подветником подветский в учен- чений подветский подветск	The right which control of the state of the		
ANIONS, meq/1:	•			
IICO3	O	4. Statement services services and appropriate condition and control c	d and the statement of	and trade to the property of the part and so the trade to
CO ₃ =	O	- 2006, "Market Market Space State Community of the Assistance of	and thing many participate programment of a "him denistration in the	an Jennerhaust, yngskis sepen yw meussianniwhaankischiskiskiskischiskassa an e
C1 -	0.073			
NO ₃	0.071			
\$0.50	HTM: (I HIM THE MAN AND AND AND AND AND AND AND AND AND A	THE PROPERTY OF THE PROPERTY O	ng 19 ang kan kan la 19 ang kanalang ang 19 ang kanalang ang 1 9	de anti-rent commence (Chill gap - CRII gaping graphings commence commence commence commence commence commence
Tall and the experience of the contraction of the c	0.053	- The state of the	ne en enimentamente as de trata (1/4) trata (1/4) trata (1/4) per proposition	gar - eringumulanisk saurenskuldur (Stepartings, nitrettil gezele etrificish i
YANIONS	0.197	manas američi apideli ilika, pateli arī paterir paraga ir apideli varionali	. Province in the contract of	And California and the consequence of the consequen
EANIONS - ECATIONS	0.015		5.9; T (1)	
0.1065 + 0.0155YANIONS	0.113		and a second	
Acceptable* Ion Balance	YES	The state of the s	TO ALCOHOL STATE OF THE STATE O	

Remarks:

P. O. Box 791 Myrtle Creek, Oregon 97457

626 N.E. Division Street Telephone (503) 863-5201

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

as	DAIL & LI	ME COLLECT	ED	
. 60648	DA-	TE RECEIVE	10-20-	78
	Da ⁻	TE REPORTE	D_12-1-78	
U	RC SAMPLE	#81020-	2	
UNITS	LIMITS	TEST RESULTS	DATE OF ANALYSIS	ANALYST
MG/L	0.05	N.D.0 0.01	10-25-78	MJS
MG/L	1.	N.D ₀ .1	11-2-78	MJS
MG/L	0.01	0.0015	11-7-78	DRG
MG/L	0.05	0.02	11-1-78	MJS
: MG/L	0.05	0.023	11-7-78	DRG
MG/L	0.002	0.28	11-9-78	DRG
MG/L	10.	0.7	10-25-78	MJS
MG/L	0,01	N.D ₀ .002	11-1-78	MJS
MG/L	0.05	N.D ₀ .01	11-1-78	MJS
MG/L	1.4 to 2.4	1.9	11-12-78	DRG
MG/L	0.0002	NOT TESTED		
MG/L	0.004	11 11		
MG/L	0.1	ii ii		
MG/L	0.005	n n		
MG/L	0.1	11 11		
MG/L	0.01	11 11		
pH Unit	<u> </u> 	3.6	10-20-78	DRG
имно/см		92	10-20-78	DRG
	. 60648 UNITS MG/L MG/L	DA- DA- URC SAMPLE UNITS LIMITS MG/L 0.05 MG/L 1. MG/L 0.01 MG/L 0.05 MG/L 0.05 MG/L 0.02 MG/L 10. MG/L 0.01 MG/L 0.05 MG/L 0.02 MG/L 10. MG/L 0.05 MG/L 0.002	DATE RECEIVE DATE REPORTE URC SAMPLE # 81020- UNITS LIMITS TEST RESULTS MG/L 0.05 N.D.@ 0.01 MG/L 1. N.Do.@ 1 MG/L 0.01 0.0015 MG/L 0.05 N.D.@ 0.02 MG/L 0.05 0.023 MG/L 0.002 0.28 MG/L 0.001 N.Do.@ 002 MG/L 0.01 N.Do.@ 002 MG/L 0.01 N.Do.@ 002 MG/L 0.01 N.Do.@ 002 MG/L 0.01 N.Do.@ 002 MG/L 0.00 N.Do.@ 003 MG/L 0.00 N.Do.@ 004 MG/L 0.000 NOT TESTED MG/L 0.004 " MG/L 0.005 " MG/L 0.005 " MG/L 0.005 " MG/L 0.001 " MG/L 0.001 " MG/	DATE RECEIVED 10-20- DATE REPORTED 12-1-78

1 EPA = Methods for the Chemical Analysis of Water & Wastes, 1974 SM = Standard Methods for the Examination of Water & Wastewater, 14th Edition

ASTM = ASTM Annual Standards, Part 31

N.D. = None Detectable

Water and Air Technology

P. O. Box 791

•

Telephone (503) 863-5201

626 N.E. Division Street Myrtle Creek, Oregon 97457

Gerald V. Colombo

David F. Putnam

TEST RESULTS

NAME	GARD, Inc.	ÀTTN Frank B	Budininkas DATE 10-20-78
Addres	S	Ave., Niles, Ill 60648	DATE REPORTED 12-1-78

	SOURCE	Set #2	ANALYSIS	ANALYST	
W.C.A.	DATE TESTED		DATE		
TEST	SAMPLE #	81020-2			
pH	pH Units	3.6	10-20-78	DRG	
SPECIFIC CONDUCTIVITY	u mho/cm	92	10-20-78	DRG	
Amonia	mg/liter	0.40	11-20-78	DRG	
CYANIDE	mg/liter	N.D.B.02	11-20-78	DRG	
GC SCAN	hydrocarbon	negative	12-1-78	GVC	
T.O.C.	mq/liter	1.2	11-27-78	DRG	
NOM - MANAGARLAMATAR _{I I} IMMANASTRAMAN ACQUARMAN TILAMA TAY SAYALIN SIMATAN SIMATAN SIMATAN		Speciments in brinding. Subsequent			
n 1886 ka ka 1886 ka 1 Inganisaran			10.	A Committee	

APPROVED BY

P. O. Box 791 Myrtle Creek, Oregon 97457

"N.L." means No Limit

means None Detectable

626 N.E. Division Street Telephone (503) 863-5201

PHYSICAL AND CHEMICAL TESTS REQUIRED BY OREGON STATE HEALTH DIVISION ADMINISTRATIVE RULES CHAPTER 333, MARCH 1976

NAME GARD, Inc. Attn: F	rank Budininkas		DATE & TIM	1E COLLECT	ED	
ADDRESS 7449 N. Natchez A	ve.,Niles,Ill. 6	0648	DAT	E RECEIVE	D 10-20-78	
	t #2			E REPORTE		
COLLECTED BY:		UR	C SAMPLE #	£ 81020-2	2	
TEST	TEST METHOD ¹	UNITS	OSHD LIMITS	TEST. RESULTS	ANALYSIS DATE	ANALYS
ACIDITY	SM 403	MG/L	N.L.	14.1	11-14-78	DRG
CALCIUM	SM 306 A	MG/L	N.L.	0.69	11-2-78	MJS
CHLORIDES	SM 408 A	MG/L	250.	5.59	10-26-78	DRG
COLOR (APPARENT)	SM 204 A	COLOR	15.	5	11-10-78	DRG
COPPER	SM 308 A	MG/L	1.0	0.04	11-2-78	MJS
FLUORIDE	SM 414 C	MG/L	2.0	1.9	11-12-78	DRG
HARDNESS (CaCO ₃)	SM 309 B	MG/L	N.L.	2.0	10-23-78	DRG
IRON	SM 310 B	MG/L	0.3	0.29	11-1-78	MJS
MAGNESIUM	SM 313 B	MG/L	N.L.	0.09	11-2-78	MJS
MANGANESE	SM 314 A	MG/L	0.05	0.01	11-2-78	MJS
NITROGEN, NITRATE	ASTM D992-71	MG/L	10.	0.7	10-25-78	MJS
NITROGEN, NITRITE	EPA p.215	MG/L	N.L.	и.р.д.ол	10-25-78	DRG
ODOR	SM 206	T.O.N.	3.	N.D.@	10-20-78	DRG
рН	SM 424	рН	N.L.	3.6	10-20-78	DRG
*POTASSIUM	SM 317 A	MG/L	N.L.	0.07	11-2-78	MJS
SAND	SM 208 D,E	MG/L ·	1	N D.G.1	11-15-78	DRG
SILICA	SM 426 B	MG/L	N.L.	0.64	11-3-78	DRG
SODIUM	SM 320 A	MG/L	N.L.	0.24	11-2-78	MJS
SOLIDS, TOTAL	SM 208 C	MG/L	1000.	1.8	11-15-78	DRG
SOLIDS, VOLATILE	SM 208 E	MG/L	N.L.	N.D.6.1	11-16-78	DRG
*SPECIFIC CONDUCTANCE	SM 205	иМНО/СМ	N.L.	92	10-20-78	DRG
SULFATES	SM 427 B	MG/L	250.	0.29	10-26-78	DRG
TURBIDITY	SM 214 A	F	Filtered 1.0 Unfiltered 5.1	N.D.8 0.1	11-10-78	DRG
ZINC	SM 023 A	MG/L	5.0	0.08]1-1-78	MJS
	•				1 _	
*Required by Laboratory for	completion of I	on Balar	ice and Qual	ity Control	of the Resu	ils.

P. O. Box 791

Myrtle Creek, Oregon 97457

626 N.E. Division Street Telephone (503) 863-5732

GARD, Inc. Niles, Ill.

ION BALANCE

Set #2

Sample No.	81020-2			
CATIONS, meg/l:	tarapanan da denar persenten anna sente transpart te tima appretenta			
Ca ⁺⁺	0.034			
Mg ⁺⁺	0.007			
K ⁺	0.002			
Na ⁺	0.010			
H ⁺	0.251			

	ran da antara da			The state of the s
ΣCATIONS	0.3 04	The second constitution of the second		
ANIONS, meg/1:	and parameter of the state of t			
нсо ₃ -	00			
CO ₃	0			
C1 -	0.158			
NO ₃	0.050			
so ₄ =	0.006			
F1	0.100			
ΣANIONS	0.314		,	
EANIONS - ECATIONS	0.100			
0.1065 + 0.0155ΣANIONS	0.116			
Acceptable* Ion Balance	YES			

Remarks:

ORIGINAL PAGE IS OF POOR QUALITY

Navidli / Ulham

*For acceptable comparability, $|\Sigma ANIONS - \Sigma CATIONS| \le 0.1065 + 0.0155\Sigma ANIONS$

P. O. Box 791 Myrtle Creek, Oregon 97457

626 N.E. Division Street Telephone (503) 863-5201

EPA INTERIM PRIMARY DRINKING WATER STANDARDS

NAME GARD, Inc. Attn:				ME COLLECT		
ADDRESS 7449 N. Natch		1. 60648		re Receive	D 10-30-7	8
WATER SOURCE	Set #3		Da ⁻	re Reporte	D 12-1-78	
COLLECTED BY:		UI		#81030-1		
TEST	TEST METHOD 1	UNITS	LIMITS	RESULTS	DATE OF ANALYSIS	ANALYS'
ARSENIC	SM 404 C	MG/L		0.01 0.01	11-1-78	MJS
BARIUM	SM 303 A	MG/L	1.	N.D.8.1	11-2-78	MJS
CADMIUM	SM 305 A.	MG/L	0.01	0.0014	11-7-78	DRG
CHROMIUM	SM 307 A	MG/L	0.05	N.D.6 0.02	11-1-78	MJS
LEAD	SM-311 A	MG/L	0.05	0.019	11-7-78	DRG
MERCURY	SM 315 A -	MG/L	0.002	0.079	11-9-78	DRG
NITRATE-NITROGEN	ASTM D992-71	MG/L	10.	0.9	11-1-78	MJS
SELENIUM	SM 318 C	MG/L	0.01	N.D.@ 0.002	11-1-78	MUS
SILVER	SM 319 A	MG/L	0.05	N.D ₀ .01	11-1-78	MJS
FLUORIDE	SM 414A & C .	MG/L	1.4 to 2.4	0.8	11-1-78	MJS
ENDRIN	SM 509 A	MG/L	0.0002	NOT TESTED		
LINDANE	SM 509 A	MG/L	0.004	11 11		
METHOXYCHLOR	SM 509 A	MG/L	0.1	11 11		
TOXAPHENE	SM 509 A	MG/L	0.005	11 11		
2,4-D	SM 509 B	MG/L	0.1	11 11		
2,4,5-TP SILVEX	SM 509 B	MG/L	0.01	11 11		
рН	SM 424	pH Unit	<u> </u>	3.9	11-1-78	MJS
SPECIFIC CONDUCTANCE	SM 205 -	имно/см		40	11-1-78	MUS

1 EPA = Methods for the Chemical Analysis of Water & Wastes, 1974 SM = Standard Methods for the Examination of Water & Wastewater, 14th Edition

ASTM = ASTM Annual Standards, Part 31

N.D. = None Detectable

Water and Air Technology

P. O. Box 791

•

Telephone (503) 863-5201

626 N.E. Division Street Myrtle Creek, Oregon 97457

Gerald V. Colombo David F. Putnam

. TEST RESULTS

NAME	GARD,	Inc.	ATTN	Frank Budininkas	DATE 10-30-78
ADDRESS	7449	Natchez Ave.	, Niles,Ill. 60	0648 BATE	REPORTED 12-1-78

DATE TESTED DATE		SOURCE	Set #3	ANALYSIS	ANALYST	
pH pH Units 3.9 11-1-78 MJS SPECIFIC CONDUCTIVITY μ mho/cm 40 11-1-78 MJS A*MONIA mg/liter 0.13 11-20-78 DRG CYANIDE mg/liter 1.0.0.0 11-20-78 DRG G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-76 DRG		DATE TESTED			71111111111	
pH pH Units 3.9 11-1-78 MJS SPECIFIC CONDUCTIVITY μ mho/cm 40 11-1-78 MJS A*MONIA mg/liter 0.13 11-20-78 DRG CYANIDE mg/liter 1.0.0.0 11-20-78 DRG G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-76 DRG	TEST	SAMPLE #	81030-1			
SPECIFIC CONDUCTIVITY		UNITS			ale Carlotte de la companya del companya del companya de la compan	
A'MONIA mg/liter 0.13 11-20-78 DRG CYANIDE mg/liter 1.D. n. 02 11-20-78 DRG G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-78 DRG	рН	pH Units				
CYANIDE mg/liter 1.D.n.02 11-20-78 DRG G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-78 DRG	SPECIFIC CONDUCTIVITY	u mho/cm	40	1	MJS	
G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-78 DRG	AMMONIA	mg/liter	0.13	11-20-78	DRG	
G.C. SCAN hydrocarbon negative 12-1-78 GVC T.O.C. mg/liter 0.9 11-27-78 DRG	CYANIDE	mg/liter	1. D. D. 02	11-20-78	DRG	
T.O.C. mg/liter 0.9 11-27-78 DRG	G.C. SCAN	hydrocarbon		12-1-78	GVC	
	T.O.C.	ادا الدائب استأن فالكب البقوات بالدائب ويهجرانية الطباء التراقي التقوات المراجعة	0.9	11-27-78	DRG	
			•			
					ary and the second second second second second	
	ATTITUDE (Trough productive) program in a partitive project in a sign and a s					
		N				
	(MCCM (14 да 14 м. сама разменту менянца, ана може на 14 м. се предестава до се подала до се постава до се пост					· · · · · · · · · · · · · · · · · · ·
	With the control of t	-			-/	

ORIGINAL PAGE IS OF POOR QUALITY

APPROVED BY - Ward

P. O. Box 791 Myrtle Creek, Oregon 97457

626 N.E. Division Street Telephone (503) 863-5201

PHYSICAL AND CHEMICAL TESTS REQUIRED BY . OREGON STATE HEALTH DIVISION ADMINISTRATIVE RULES CHAPTER 333, MARCH 1976

NAME GARD, Inc. Attn: Fr	rank Budininkas		DATE & TIM	E COLLECT	ED	
ADDRESS 7449 N. Natchez /	Ve., Niles, Ill	. 60648			D 10-30-78	
WATER SOURCESet #3	}				D 12-1-	
COLLECTED BY:		UR	C SAMPLE #			
TEST	TEST METHOD ¹	UNITS	OSHU LIMITS	TEST RESULTS	ANALYSIS DATE	ANALYS
ACIDITY	SM 403	MG/L	N.L.	8.4	11-14-78	DRG
CALCIUM	SM 306 A	MG/L	N.L.	0.92	11-2-78	MJS
CHLORIDES	SM 408 A	MG/L	250.	1.5	11-10-78	DRG
COLOR (APPARENT)	SM 204 A	COLOR	15.	5	11-1-78	RD
COPPER	SM 308 A	MG/L	1.0	и.D.0 0.01	11-2-78	11JS
FLUORIDE	SM 414 C	MG/L	2.0	0.8	11-1-78	MJS
HARDNESS (CaCO ₃)	SM 309 B	MG/L	N.L.	2	11-10-78	DRG
IRON	SM 310 B	MG/L	0.3	0.09	11-1-78	MUS
MAGNESIUM	SM 313 B	MG/L	N.L.	0.04	11-2-78	MJS
MANGANESE	SM 314 A	MG/L	0.05	N.D.β.01	11-2-78	MUS
NITROGEN, NITRATE	ASTM D992-71	MG/L	10.	0.9	11-1-78	MJS
NITROGEN, NITRITE	EPA p.215	MG/L	N.L.	0.13	11-1-78	MJS
ODOR	SM 206	T.O.N.	3	N.D.	11-2-78	DRG .
рН	SM 424	рН	N.L.	3.9	11-1-78	MJS
*POTASSIUM	SM 317 A	MG/L	N.L.	0.13	11-2-78	MJS
SAND	SM 208 D,E	MG/L	2.	N.D.6.1	11-15-78	DRG
SILICA	SM 426 B	MG/L	N.L.	0.21	11-3-78	DRG
SODIUM	SM 320 A	MG/L	N.L.	0.27	11-2-78	MJS
SOLIDS, TOTAL	SM 208 C	MG/L	1000.	3.0	11-15-78	DRG
SOLIDS, VOLATILE	SM 208 E	MG/L	N.L.	N.D.@	11-16-78	DRG
*SPECIFIC CONDUCTANCE	SM 205	имно/см	N.L.	40	11-1-78	MJS
SULFATES	SM 427 B	MG/L	250.	N.D ₀ 05	11-15-78	DRG
TURBIDITY	SM 214 A	F	Filtered 1.0 Unfiltered 5.0	N.D001	11-1-78	RD
ZINC	SM 323 A	MG/L	5.0	0.18	11-1-78	Mas
	•••			<u> </u>		

*Required by Laboratory for completion of Ion Balance and Quality Control of "N.L." means No Limit

N.D. means None Detectable

P. O. Box 791 Myrtle Creek, Oregon 97457 626 N.E. Division Street Telephone (503) 863-5732

GARD, Inc. Niles, Ill.

ION BALANCE

Set #3,

	· · · · · · · · · · · · · · · · · · ·	A			T		
Sample No.	81030-1	where is an activation of the contract of the		ement in annual and a comment of the			
CATIONS, meq/l·			į.				
Ca ⁺⁺	0.046	то стиненция (переийский слада, учарация или експективного		······································		-	
Mg ⁺⁺	0.003	err may symanty it symbolytick your a syclife bland drope		regermenterales their some scalesta police		scup needstatistisse gavicustiss	
K ⁺	0.003						di saminingan mengangan bah bah bah bah
Na ⁺	0.012			Committee and a service and a			****
H [†]	0.126					ng <u>sidenthing lan</u> a gairsi ya	
	W. W. T.	***		· · · · · · · · · · · · · · · · · · ·			· ************************************
		e Newsgangan and and de la contact years and a					
ECATIONS	0.190	mak san yang ngawapan saya ing kang ya majangan		and the latter was a second second			10 4 -1844
ANIONS, meq/1:	Nichter Ampriggerungerungen des Germannen Amprica (d. p. 10). pl. 1923 beginn	er jamotomių vais vienes tirtijo yšt. sikoliš 1964s. ur	under den d				productional-model (AGA) just to distrib
HCO3-	0						
CO ₃ =	0						
C1 -	0.042						
NO ₃	0.064						
S0 ₄	0	The second secon				,	
F1 -	0.105	TO AND					And the second second
XANIONS	0.211			aggirintat teda). 1944 gaine tillessamerind 1945 tillesta Asacca Leavy Afrika samtois:			
EANIONS - ECATIONS	0.021		th Majoritina (emprilate prilate franchische p				
0.1065 + 0.0155EANIONS	0.113	The state of the s					
Acceptable* Ion Balance	YES						

Remarks:

Dowist of whom

^{*}For acceptable comparability, $|\Sigma ANIONS| = \Sigma CATIONS| \leq 0.1065 + 0.0155\Sigma ANIONS|$

So, to 41

UMPQUA RESEARCH COMPANY

Ion Balance and Data Check Sheet

Sample # # #15:20-1

Site N.165, 211

Client GARD Inc

Source MACA - Water iterated Calc by 1919

				•
CATIONS	<u>mg/1</u>	<u>me/1</u>		μmho-cm ⁻¹ @ 25°C
Ca ⁺⁺ =	6.73	: 20.04 = 0.036	x 52.0 =	1.9
Mg ⁺⁺ =	1.09	÷ 12.16 = 0.057	x 46.6 =	•3
		÷ 39.10 =		
i i		÷ 22.99 = <u>0.010</u>		
· H.4 =		÷ = 0.153	- -	
Σ CATIONS=		Σ CATIONS= 6 12 12	Σ CATIONS=	
ANIONS				
HCO3=	grape B. P.F. is taking the second control of the control of t	÷ 61.02 =	$_{x}$ 43.6 =	annin magainn an ann an Aonachta Bash leithean an an an an ann an ann an an an an an
co ₂ ==	A DE POPULATION DE	÷ 30.01 =	_ x 84.6 =	in the control of the
	CF 1 19	÷ 35.45 = <u>0.073</u>	$_{x}$ 75.9 =	a againg "paragambahy myana manyaka kamushasanan minkanan makaka kama kama kama kama kama k
1.0° $1.0^$	4.13	\div 62.01 = 0.071	_ x 71.0 =	project the state of the state
$\frac{1}{10}$	14.7.	÷ 48.03 =		
Pro =	1.6	÷ 19 = 0.053		planta and an international and the second s
∑ ANIONS≕	NAME OF THE PERSON NAME OF THE PERSON NAMED OF	Σ ANIONS = 0.197 Σ	: ANIONS =	Jan - Janes Janus de Contracte de la compressión del compressión de la compressión d
∑ IONS≃		Δ10NS = 0.616]: IONS =	
TDS=		$\Delta MAX = \frac{\pm 0.113}{2}$	_ K ∞=	
SiO ₂ =2.14 Si=		TDS K =	K =	57
•		- Normal =	pH =	2, 3
TS=				And the state of t
	NOTES	- S	HARDNES	S AS CaCO ₃
1. HCO ₂ =		as CaCO ₃ x1.22 =		
		if pH > 8.3		116 =
¥	E Σ ANIONS -			142 =
		+ 0.0155 Σ ANIONS)		792 =
	(_d - (D - 1)k			564 =
	u	w ilution required to make		531 =
•		0 ≤ K ≤ 120 μmho-cm ⁻¹	Mn x 1.	
		<u>s + Vw</u>	. T(DTAL =
		vs Volume of Sample		IDTA = いて
	Vw = \	volume of Distilled Water		
	Kd -= 1	K of Diluted Sample K of Distilled Water (< 2	umbo-cm-1	1
	1/14 -2 [N of Distilled Mater (C 2	pilitio-ciii)	

Sit 2.

UMPQUA RESEARCH COMPANY

2-05018

Ion Balance and Data Check Sheet

Sample # GAID, INC Site Miles TII

Source Mish. Wider in cody Calc by DFP 11-21-78

<u>C</u>	TIONS	<u>mg/l</u>		<u>me/1</u>		umho-cm ⁻¹ @ 25°C	
	Ca ⁺⁺ =	0.69	÷ 20.04 =	0.034	x 52.0 =	1.8	
	Mg ++ =	०००	_	0.007	-		
	K ⁺ =	0,67	* **	A.00%	•	0.1	
	Na =	0.24	*	0.010	-	0.5	
	H+ =		÷ ##	0.25!	- -	& 90	
Σ CA	TIONS=		Σ CATIONS=	0.004	g CATIONS=		
<u> </u>	NIONS	Section 1	o # /	- -	* * * * *	مسرع	
	HC03 =	49,-2-	÷ 61.02 = .	0.282	x 43.6 =	12-7	
	co3==	the safety silling as the sequence with selling the decrease and security and	30.01 = _	S Saland Aller Germany (1984) and a speciment of the speciment of the specimens of the spec	x 84.6 =		
	C1 =	5.59	÷ 35.45 = _	0.158	x 75.9 =	• 	
4.43 × 07	NO3_ =	3.10	÷ 62.01 = _	0.050	x 71.0 =		
	so ₄ =	0.29		0.006	\times 73.9 =	0,4	
	F1- =	1.9	_	00/00	x =	the set in the second of the second s	
	NIONS=	bit manningia, man manufasti. His pamaingia, cuidh int hispoiada			ANIONS =		
	∑ IONS=		1	y volg	Σ IONS =	. Designation of the second materials are assessed to the second of the	
	TDS≈	de de la companya del companya de la companya del companya de la companya del la companya de la	l L	0.116	. K∞=		
SiO ₂ =2.	14 Si=		Normal =		\ K =	72	
1.02 1.	TSS=			0.55 to 0.7	pH ≂	(3.6)	
	TS=	1.8	50] "		
	**	NOTES			HARDNES	SS AS CaCO ₃	
1. 1	1CO2 =	Alkalinity as	: CaCO ₂ /4./	x1.22 = 17.2	Ca x 2	.497 = 3 1.72	
2. 0	:0 ₂ = P	resent only i	f pH > 8.3	•	Mg X 4.	.116 = 37	And Andrews State of
	J	Σ ANIONS -			Sr x 1	.142 =	
4. /	= XAM Z	± (0.1065 +	0.0155 Σ ANI	ONS)	Fe x 1.	.792 = .52	
5. K	ς _∞ = DK	d - (D - 1)K			A1 x 5.		
		ere: D = Dil		red to make	Zn x 1.	.531 =	
		90	≤ K ≤ 120 μn	nho-cm ⁻¹	Mn x 1	.822 =	ngahiya na canan
		$=\frac{Vs}{V}$	+ <u>VW</u>		T	TAL =	
		Vs ≕ Vo	lume of Samp	o1e	Ë	EDTA = 2.0	
		Vw = Vc	dume of Dist	tilled Water			
		Kw = K	of Diluted S	d Water (< 2	umho-cm ⁻¹))	

Sample # 8103x-1	Site	g Data Greek She	gris (s	
Client	Source	and the second of the second o	_ Calc b	भू व्याप्तक के विकास के प्राप्त के किए के किए के किए के किए के किए किए के किए
The state of the s				,
CATIONS	mg/1	me/l		umho-cm ⁻¹ @ 25°C
Ca ⁺⁺ ≈	<u>c.92</u> ÷ 20.04 =	. d. ailt,	< 52.0 =	# 1 · · · · · · · · · · · · · · · · · ·
Mg ⁺⁺ =	÷ 12.16 =	6.00%	46.6 =	
K ⁺ =	<u> </u>			
Na ⁺ =	<u>C. 7</u> + 22.99 =	-	< 48.9 =	& :
new team team team team team team team team	B A B TO TO THE STATE OF THE ST	· College	=	ik en til still de sammen en e
Σ CATIONS=	Σ CATIONS:	· · · · · · · · · · · · · · · · · · ·	CATIONS :	ausaa kirin uuigu, qalluluun aha uusiyoontoontoontoo aa a
ANIONS				
HCO ₃ =	÷ 61.02 =		< 43.6 =	уст месунализминализминализмина глантит пертоји у чинорг полока
CO ³ =	÷ 30.01 =	Seri-danomas didenmas, mazindainiam czypicamy,anincjinumus, maz	< 84.6 =	de to describing and resource stands in the relative states and the collection of the second stands and the second stands are
	1. 5			
> NO ₃ =	÷ 62.01 =	· Constitution (Constitution (k 71.0 =	e Canadagua nakrubar narokana kata pa gustyar kan tira tira sanan yangunan da
\$0 ₄ =	÷ 48.03 =	·	k 73.9 =	
TO THE STATE SHAREST	2.0 190	· Callet	₹ =	garantaying, yiliyaran nagar nagare na dine nidan historiya da yaran nida naga naganna
Σ ANIONS=	S ANIONS =			
Σ IONS=	A IONS =	S S S S S S S S S S S S S S S S S S S	: IONS =	Constitutive processes in the second
TDS=	× XAM Δ MAX =		K _ω =	ration refriences and automorphy major representations and representations and representations are a section of
SiO ₂ =2.14 Si=	TDS Normal		Κ =	Ú.
. (-		0.55 to 0.7		C 3: 1 1/2
TS=	of trace with delical legion, prior demands of the		μ.,	immunitaria de la compania del la compania del la compania de la compania del la comp
· · · · · ·	NOT ES		HARDNES	S AS CaCO ₃
1. HCO ₂ = A1	kalinity as CaCO, 🌊	$\frac{d}{d}$ x 1.22 = $\frac{10.00}{10.00}$	Ca x 2.	497 =
2. CO ₂ = Pre	sent only if pH > 8.	.3		116 = 0.2
4	E ANIONS - Σ CATIONS			142 =
	(0.1065 + 0.0155 Σ A			
5. $K_{\infty} = DK_{d}$				564 =
4	e: D = Dilution requ			
	90 ≤ K ≤ 120	~	Mn x 1.	
	$=\frac{V_S + V_W}{V_S}$	•		TAL =
	Vs = Volume of G	.m.v.7.e		DTA = 2

Vs = Volume of Sample
Vw = Volume of Distilled Water
Kd == K of Diluted Sample
Kw = K of Distilled Water (< 2 µmho-cm⁻¹)

GRUDNAL PAGE OF